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Gold Nanoparticles Sliding on Recyclable Nanohoodoos as SERS Substrates – Bridging the Gap between Low Cost and Excellent Performance

Kaiyu Wu[1,2*], *Tao Li*[1], *Michael S. Schmidt*[1,2], *Tomas Rindzevicius*[1,2], *Sokol Ndoni*[1], *Anja Boisen*[1,2]

[1]Department of Micro- and Nanotechnology, Technical University of Denmark, Ørsteds Plads, Building 345B, 2800 Kgs. Lyngby, Denmark

[2]DNRF and Villum Fonden Center for Intelligent Drug Delivery and Sensing Using Microcontainers and Nanomechanics, IDUN, Technical University of Denmark, Ørsteds Plads, Building 345C, 2800 Kgs. Lyngby, Denmark

[*]*Email address:kaiwu@nanotech.dtu.dk*

The development of nanostructured surfaces as substrates for surface-enhanced Raman spectroscopy (SERS) has been a hot topic in the field, since the success of SERS in practice relies on the availability of highly enhancing, macroscopically uniform, cheap and reproducible substrates. Herein, I present a novel substrate that might prove advantageous with respect to all the expected properties of an ideal SERS substrate.[1] The substrate consists of gold nanoparticles that can slide and aggregate on dense and recyclable alumina/silicon nanohoodoos, which are fabricated in wafer-scale using block copolymer lithography.[2] The substrate can be used for both gas and liquid sensing. Hot-spot engineering is conducted to maximize its SERS performance. The developed substrate demonstrates remarkably large surface-averaged SERS enhancements, greater than 10^7 (>10^8 in hot spots), with unrivalled macroscopic signal uniformity as characterized by a coefficient of variation of only 6% across 4 cm. Interestingly, after SERS analyses, the nanohoodoos can be recycled by complete removal of gold via a one-step, simple, and robust wet etching process without compromising performance, minimizing the cost. After 8 times of recycling, the substrate still exhibits identical SERS performance in comparison to a new substrate. Our work facilitates the practical use of SERS for both laboratorial and commercial applications.

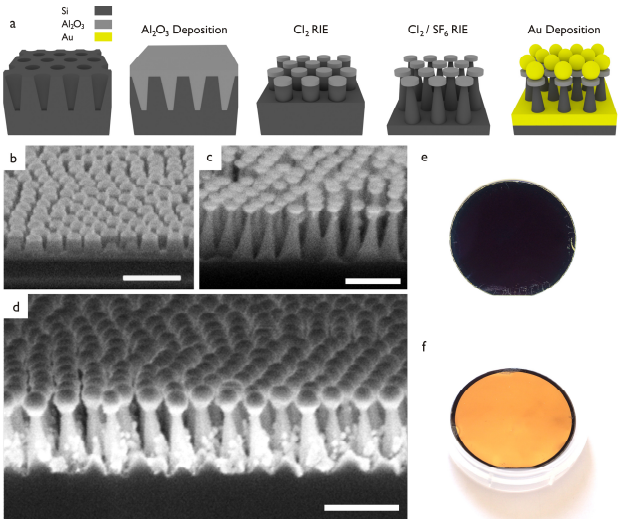

Figure 1. a) Schematic of the nanofabrication. b-d) SEM images taken between and after the last 3 process steps in a). e,f) Pictures of 2-inch wafers covered with arrays of nanohoodoos before and after gold deposition, respectively.

References:

1. Wu, K.; Li, T.; Schmidt, M. S.; Rindzevicius, T.; Boisen, A.; Ndoni, S. *Adv. Funct. Mater.* **2018**, 1704818

2. Li, T.; Wu, K.; Rindzevicius, T.; Wang, Z.; Schulte, L.; Schmidt, M. S.; Boisen, A.; Ndoni, S. *ACS Appl. Mater. Interfaces* **2016**, *8*, 15668.